# Simulations for T2 wobbling station in CERN's North Area

K. Mitsidi[1,2], N. Charitonidis[1], F. Metzger[1] , F. Stummer[1,3]

[1] CERN, 1211, Meyrin, Switzerland
[2] University of Cyprus, Nicosia, Cyprus
[3] JAI at Royal Holloway University of London, TW20 0EX, Egham, United Kingdom

University of Cyprus
Department of Physics

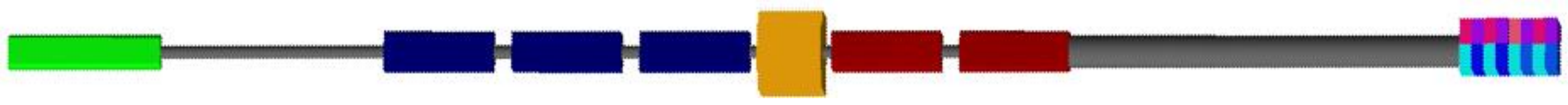


Figure 1: BDSIM [2] model of T2 wobbling station.

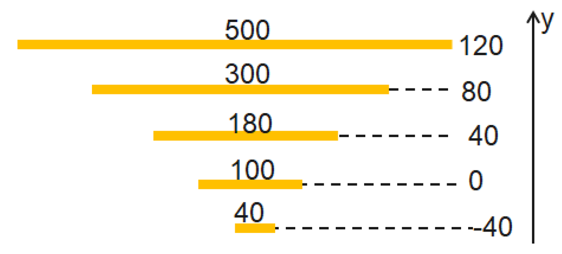



Figure 3: Target layout. The length and position of each plate is shown above and next to them in mm.

Legend:
- B1 magnet
- B2 magnet
- T2 target
- B3 magnet
- Vacuum tube
- H2 TAX
- H4 TAX
- primary proton beam
- Neutral particles

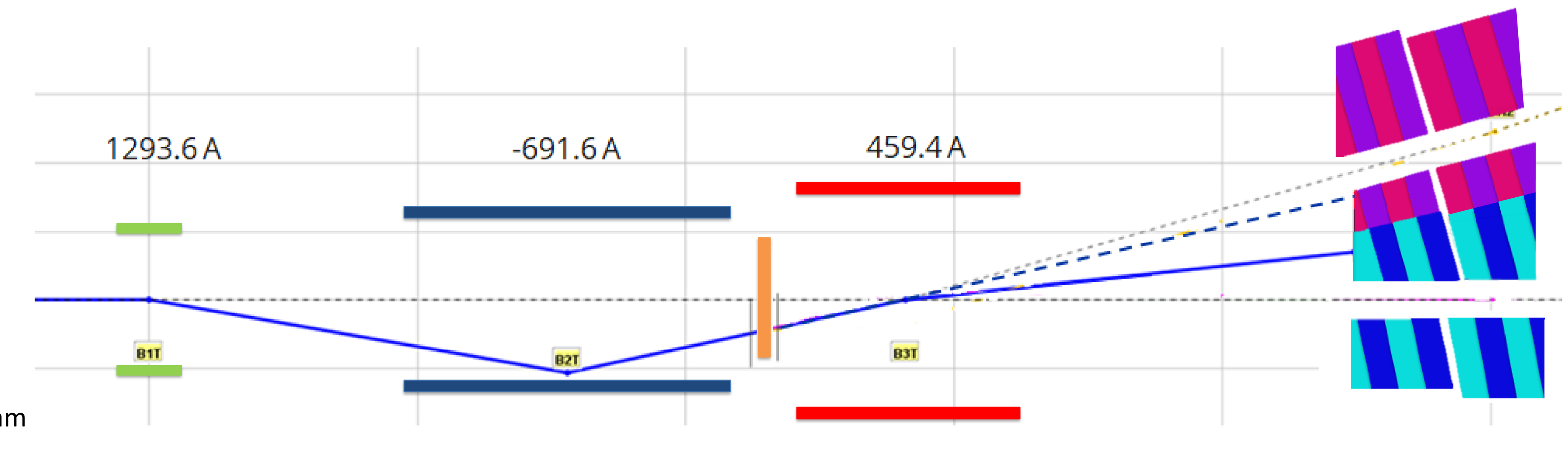



Figure 2: A representation of the setting used in BDSIM T2 wobbling station simulation. The currents used in each magnet are shown above them in A.

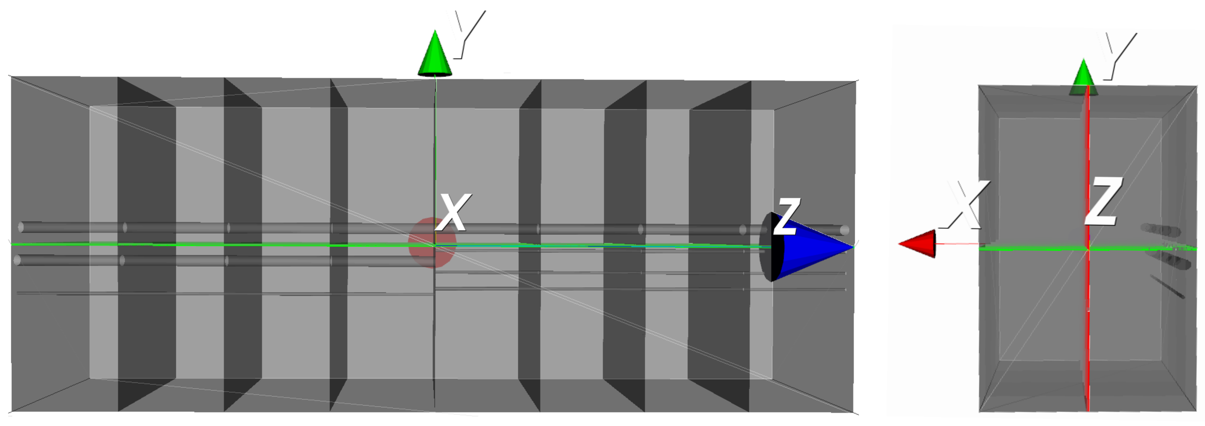



Figure 4: H2 TAX structure in Pyg4ometry [3]. Shown from the side and the beam direction.

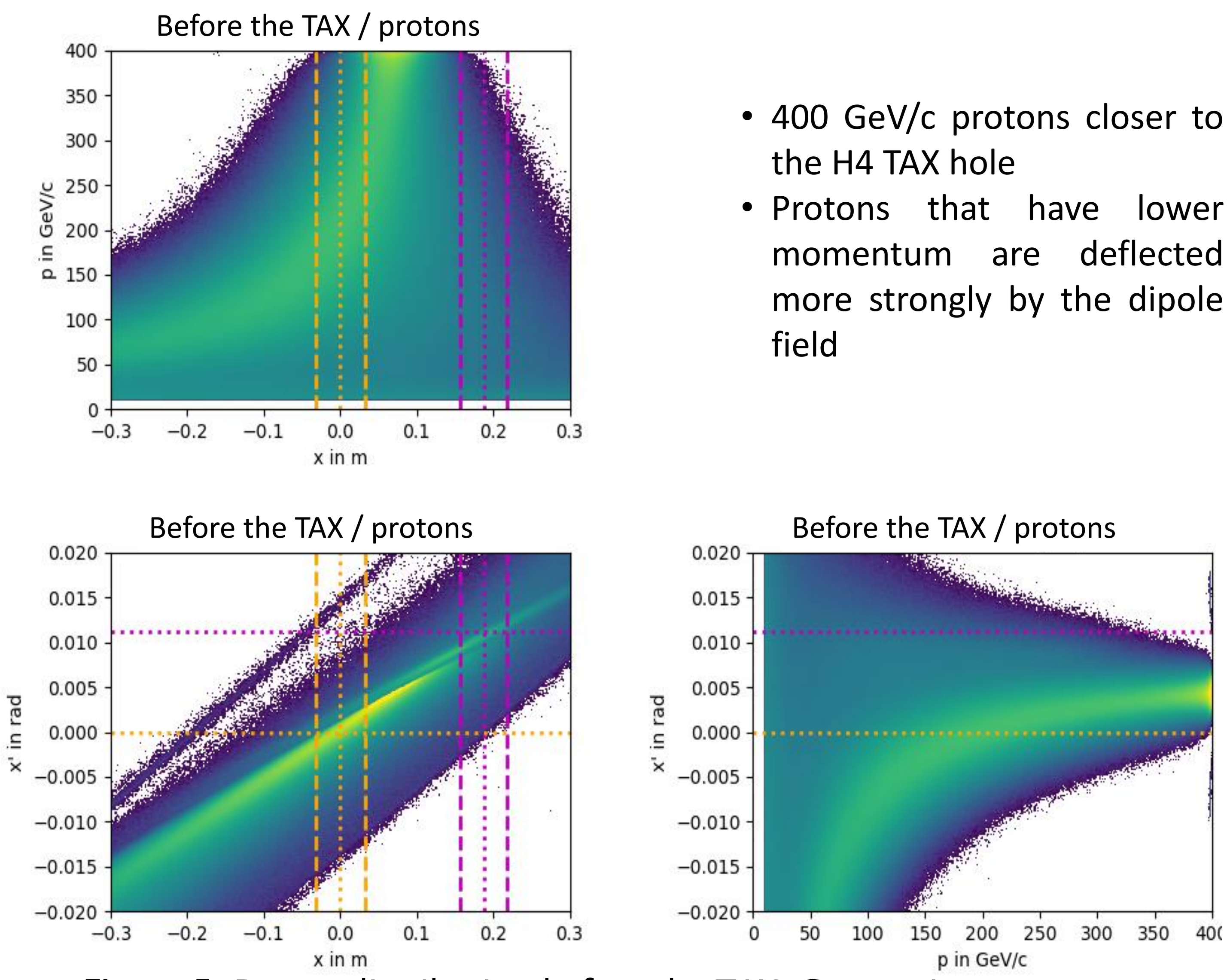
## Abstract

CERN'S North Area consists of many secondary beamlines and some of those originate from the same production target and primary proton beam. To serve multiple secondary lines at the same time the so-called Wobbling Stations are used [1]. They deflect the primary protons in such a way that they collide with the target and the parts of the produced secondaries can be sent into the beamlines of interest. Two of these beamlines are the H2 and H4 beamlines that are connected to the T2 target wobbling station. BDSIM [2] provides the opportunity to simulate different wobbling settings, using Monte Carlo techniques that allow accurate predictions of the real beamlines. So far, a model regarding the wobbling station has been created and is being tested with different settings by changing the target and TAX placement and the input of the currents. A sampler has been placed before and after the TAX, which filters everything that enters the beamlines, and is able to recognize the protons from all the other particles. With the T2 wobbling model having been tested and validated, it is now possible to use its output in simulations of the beamlines downstream.

## Simulation Outcome

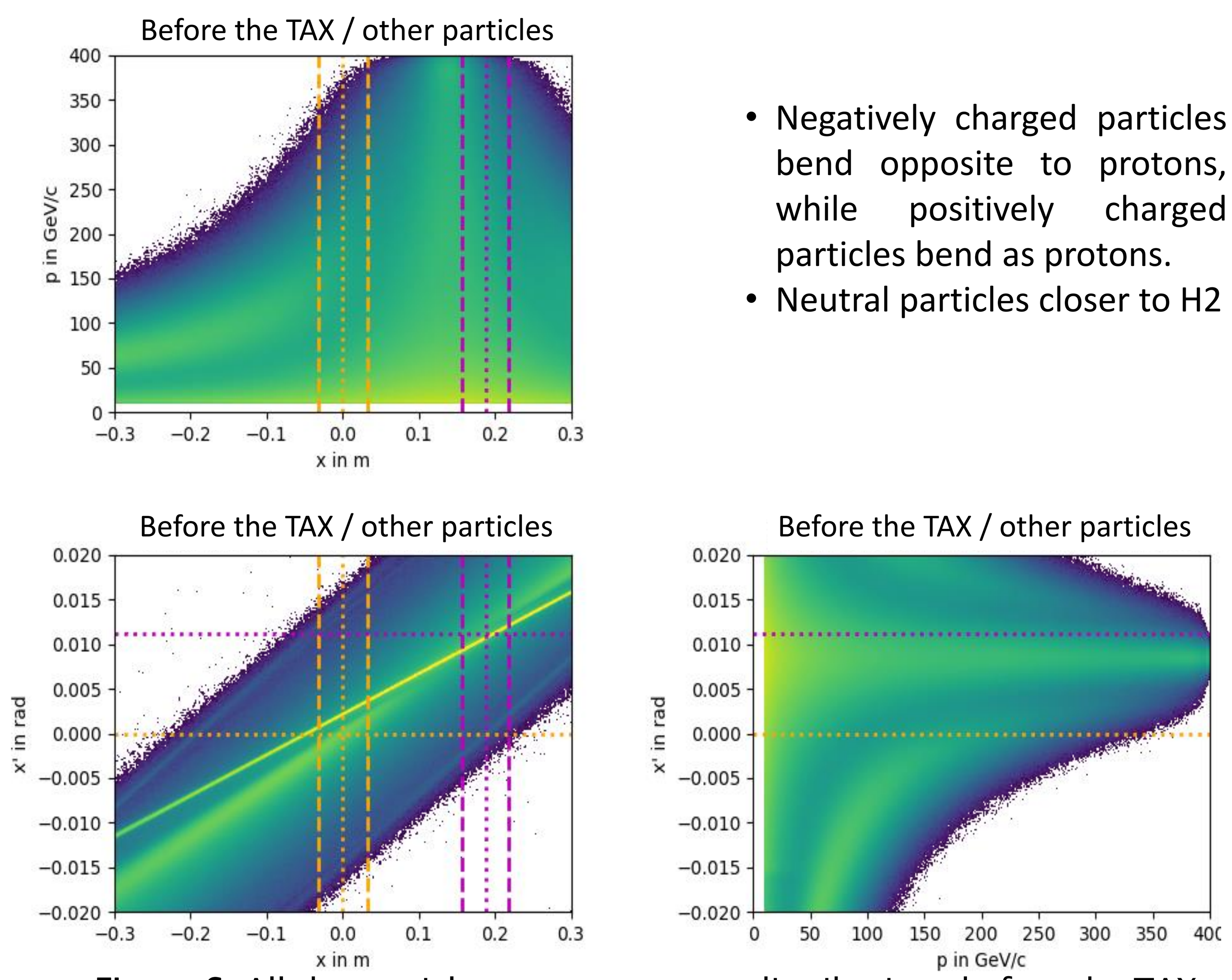
B
E
F
O
R
E

T
A
X



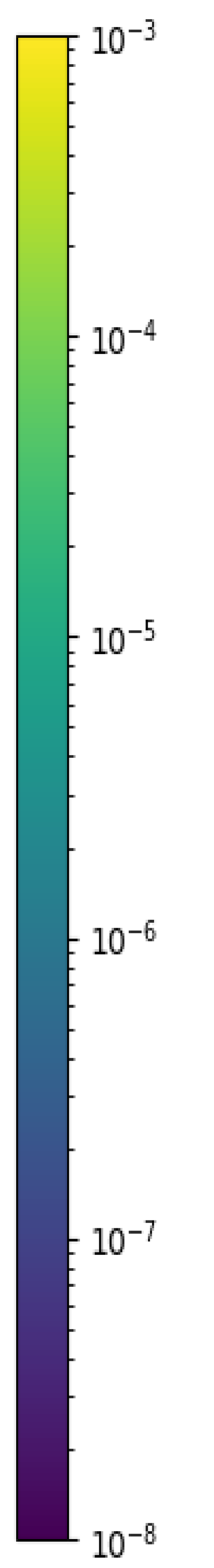

- 400 GeV/c protons closer to the H4 TAX hole
- Protons that have lower momentum are deflected more strongly by the dipole field

Figure 5: Proton distribution before the TAX. Connecting: momentum, x position and angle.




- Negatively charged particles bend opposite to protons, while positively charged particles bend as protons.
- Neutral particles closer to H2

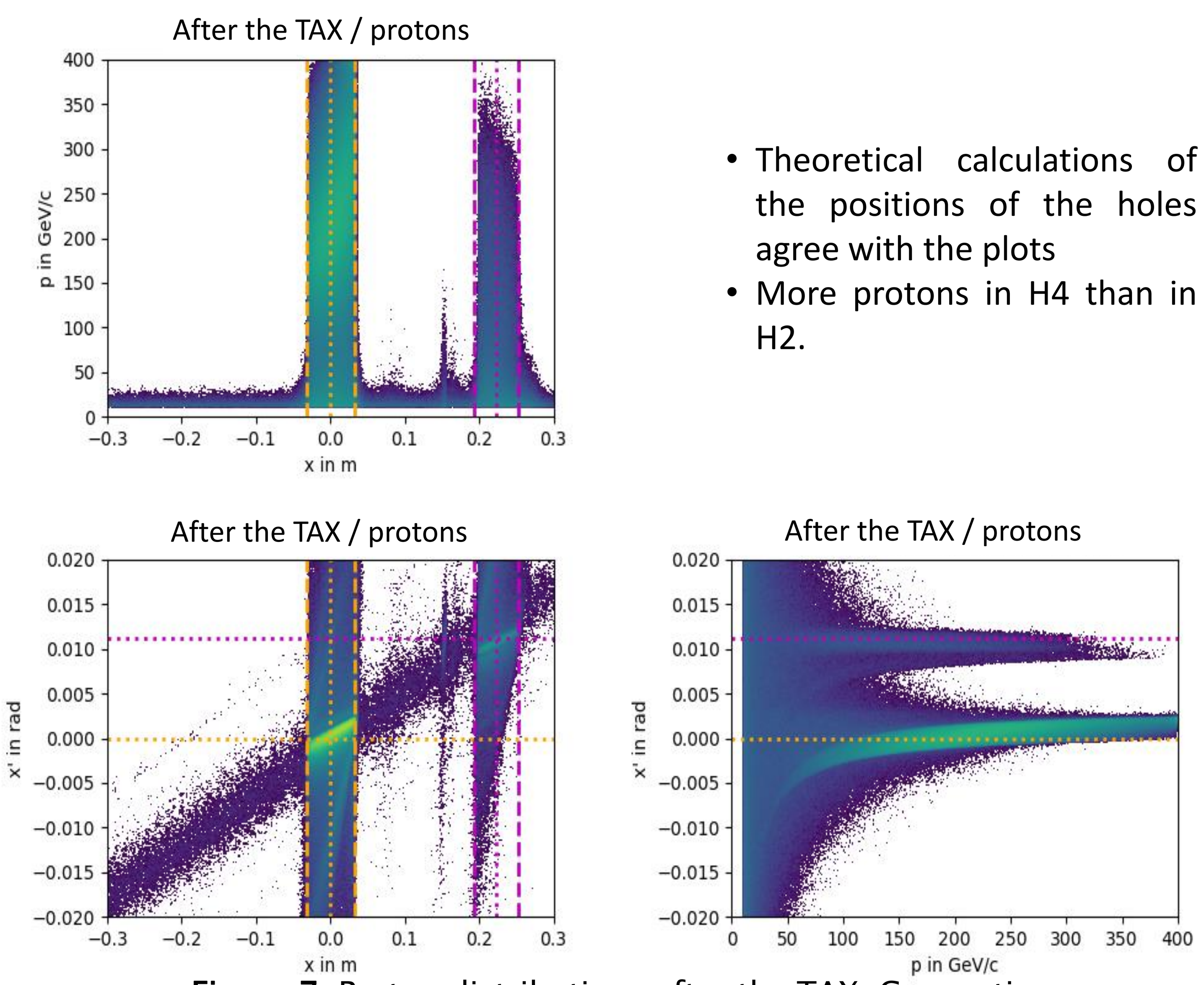
Figure 6: All the particles except protons distributions before the TAX. Connecting: momentum, x position and angle.




Particles per primary proton / 0.002 m / 0.0001 mrad / 1 GeV/C

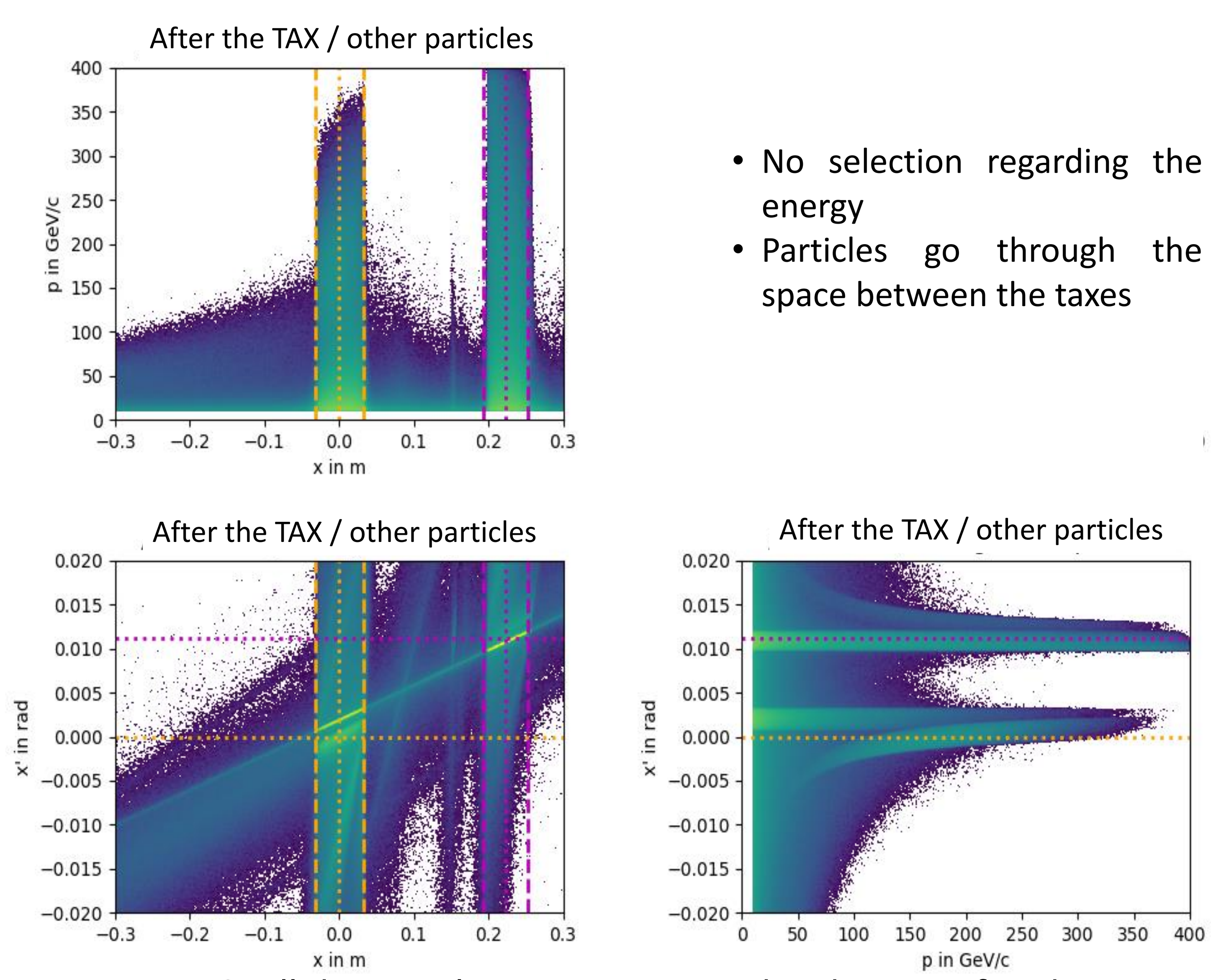
A
F
T
E
R

T
A
X




- Theoretical calculations of the positions of the holes agree with the plots
- More protons in H4 than in H2.

Figure 7: Proton distributions after the TAX. Connecting: momentum, x position and angle.




- No selection regarding the energy
- Particles go through the space between the taxes

Figure 8: All the particles except protons distributions after the TAX. Connecting: momentum, x position and angle.

## References

[1] L. Gatignon, Design and tuning of secondary beamlines in the CERN north and east areas, CERN-ACC-NOTE-2020-0043, CERN Document Serv. (2020) 33–48,
URL http://cds.cern.ch/record/2730780.

[2] L.J. Nevay et al., BDSIM: An Accelerator Tracking Code with Particle-Matter Interactions, Computer Physics Communications 252 107200 (2020).

[3] S.D. Walker, A. Abramov, L.J. Nevay, W. Shields, S.T. Boogert, pyg4ometry: A Python library for the creation of Monte Carlo radiation transport physical geometries, Computer Physics Communications 272 108228 (2022).

- Email: kyproula.mitsidi@cern.ch